WORKSHEET FOR REACTOR AND PLANT SYSTEM DEGRADED CONDITIONS

Reference/Title (LER #, Inspection Report #, etc): **PWR EXAMPLE 3**

Factual Description of Identified Condition (statement of facts known about the issue, without hypothetical failures included):
During a period of sub-zero temperatures, the licensee discovered that the minimum recirculation lines from the Safety Injection (SI) pumps were frozen. The licensee estimated that this condition had existed for 7 days.

System(s) and Train(s) with degraded condition: **Both trains of Safety Injection**

Licensing Basis Function (if applicable): **ECCS injection**

Maintenance Rule category (check one): _**U**___ risk-significant _____ non-risk-significant
Time degraded condition existed or assumed to exist: **7 days**

Functions and Cornerstones degraded as a result of this condition (check T)

INITIATING EVENT CORNERSTONE

_____ Transient initiator contributor (e.g., reactor/turbine trip, loss offsite power)

_____ Primary or Secondary system LOCA initiator contributor (e.g., RCS or main steam/feedwater pipe degradations and leaks)

MITIGATION CORNERSTONE

___**U**___ Core Decay Heat Removal

__**U**__ Initial injection heat removal paths

_**U**___ Primary (e.g., Safety Inj)

____ Low Pressure

_**U**__ High Pressure

_____ Secondary - PWR only (e.g., AFW)

__**U**__ Long term heat removal paths (e.g., contmt sump recirculation, suppression pool cooling)

_____ Reactivity control

BARRIER CORNERSTONE

_____ RCS LOCA mitigation boundary degraded (e.g., PORV block valve, PTS issue)

_____ Containment integrity

_____ Breach or bypass

_____ Heat removal, hydrogen or pressure control

_____ Fuel cladding degraded

PHASE 1 SCREENING PROCESS
Check the appropriate boxes **U**

Cornerstone(s) assumed degraded:

9 Initiating Event **:** Mitigation Systems **9** RCS Barrier **9** Fuel Barrier **9** Containment Barrier

If more than one Cornerstone is degraded, then go to Phase 2. If NO Cornerstone is degraded, then the condition screens OUT as "Green" and is not assessed further by this process.

If only one Cornerstone is degraded, continue in the appropriate column below.

Initiating Event	Mitigation Systems	RCS Barrier	Fuel Barrier	Containment Barrier
1. Does the issue contribute to the likelihood of a Primary or Secondary system LOCA initiator? **9 If YES ý Go to Phase 2** If NO, continue 2. Does the issue contribute to both the likelihood of a reactor trip AND the likelihood that mitigation equipment will not be available? **9 If YES ý Go to Phase 2** **9** If NO, screen OUT	1. Is the issue a design or qualification deficiency that does NOT affect operability per GL 91-18 (rev 1)? **9 If YES ý Screen OUT** If NO, continue **2. Does the issue represent an actual Loss of Safety Function of a System?** **☒ If YES ➔ Go to Phase 2** If NO, continue 3. Does the issue represent an actual Loss of Safety Function of a Single Train, for > TS AOT? **9 If YES ý Go To Phase 2** If NO, continue 4. Does the issue represent an actual Loss of Safety Function of a Single Train of non-TS equipment designated as risk-significant under 10CFR50.65, for > 24 hrs? **9 If YES ý Go To Phase 2** **9** If NO, screen OUT	**9** 1. **Go to Phase 2**	**9** 1.Screen OUT	1. TBD

Result of the Phase 1 screening process: _____ screen OUT as "Green" ___**U**__ go to Phase 2

Important Assumptions (as applicable):

Operator cannot recover SI system.

Example initiating scenarios to be considered

Affected system	Major Components	Support Systems	Initiating Event Scenarios
AFWS	AFWTDP/Valves Control I&C	125 V-DC 115 V-AC	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks, ATWS
	AFWMDP Control I&C	4KV bus A&B 125 V-DC, 28 VDC, 115 V-AC, and HVAC	
HHSI & HHSI (Recirc)	Pumps Valves I&C including DC for 4.16 KV breakers	4.16KV, and 125VDC, 28 VDC, SW, CCW, and HVAC	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks, ATWS
SI & SI (Recirc.)	Pumps Valves	4.16KV, and 125VDC, 28VDC, SW, CCW, and HVAC	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks.
LPSI/RHR/ (Recirc.)	Pumps Valves	4.16KV, and 125VDC, 28 VDC, SW, CCW, and HVAC	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks, M/L LOCA
CS & CS (Recirc.)	Pumps Heat Exch. Valves	4.16 KV, 125 VDC, CCW, 28 VDC, HVAC, SW	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks, M/L LOCA
EDG	Cooling (unit1 only) HVAC Start system Fuel system	Service Water, 125 VDC, 28 VDC, and HVAC	LOOP
CCW	Pumps Valves Heat Exch.	41.6 KV,125 VDC, 28 VDC, SW for room cooling	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks, M/L LOCA, ATWS
Service Water	Pumps Vlaves	4.16 KV, 125 V DC	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks, M/L LOCA, ATWS
SG PORV	Valves	115 VAC Control Air	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks, M/L LOCA, ATWS
PORV	Valve	125 VDC 28 VDC and 115 VAC (for Control)	Transient[1], LOOP, MSLB (Outside Cont.), SGTR, SLOCA from PORV/SRV/RCP, MFLB, MSLB (inside Cont.), SLOCA from pipe breaks, M/L LOCA, ATWS
Accumulators	Valves	Nitrogen	M/L LOCA

[1]Note: Transient scenarios should be developed from those transient initiators that could have the greatest risk significance. For example, develop loss of DC bus transient scenarios for degraded 125v DC or AC power equipment, as well as other transient initiators that may depend on equipment being supplied from degraded power sources. The choice of which transient scenarios to develop should generally be apparent from the specific given condition.

Row	Approx. Freq.	Example Event Type	Estimated Likelihood Rating		
I	>1 per 1 - 10 yr	Reactor Trip Loss of Power Conv. Sys. (loss of condenser, closure of MSIVs, loss of feedwater)	**A**	**B**	**C**
II	1 per 10 - 10^2 yr	Loss of Offsite Power Small LOCA (BWR) (Stuck open SRV only) MSLB (outside cntmt)	**B**	**C**	**D**
III	1 per 10^2 - 10^3 yr	SGTR Stuck open PORV (PWR) Small LOCA (PWR) (RCP seal failures and stuck open SVs only) MFLB MSLB (inside PWR cntmt)	**C**	**D**	**E**
IV	1 per 10^3 - 10^4 yr	Small LOCA (pipe breaks) ATWS-PWR (elect only)	**D**	**E**	**F**
V	1 per 10^4 - 10^5 yr	Med LOCA Large LOCA (BWR) ATWS-BWR	**E**	**F**	**G**
VI	<1 per 10^5 yr	Large LOCA (PWR) ATWS-PWR (mech only) ISLOCA Vessel Rupture	**F**	**G**	**H**
			> 30 days	30-3days	<3 days
			Exposure Time for Degraded Condition		

Table 1 - Estimated Likelihood for Initiating Event Occurrence During Degraded Period

PHASE 2 RISK ESTIMATION WORKSHEET

Transient

Estimated Frequency (Table 1 Row) I **Exposure time** 7 days **Table 1 result (circle):** A (B) C D E F G H

Safety Functions Needed:	***Full* Creditable Mitigation Capability for each Safety Function:**
Power Conversion System (PCS)	**1 / 2 Feedwater trains and 1/3 condensate pump (1 multi-train system requires operator action)**
Secondary Heat Removal (AFW)	**1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 diverse train)**
Primary Heat Removal, Feed/Bleed (FB)	**2 / 2 PORVs open for Feed/Bleed (operator action under high stress)**
High Pressure Injection for FB (EIHP)	**1 / 2 Charging trains or 1 / 2 SI trains (2 multi-train system)**
High Pressure Recirc (HPR)	**1 / 2 Charging trains or 1 / 2 SI trains taking suction from 1 / 2 LPSI trains (LPSI= 1 multi-train system but also requires human action for switching the suction to sump)**
Low Pressure Recirc (LPR)	**1 / 2 LPSI trains (1 multi-train system but it also requires manual action for switch over to sump)**
Contmt Press/Temp Control (CNT)	**1 / 2 CS trains (1 multi train system) or 3 / 5 CFCU trains (1 multi-train systems)**

Circle affected functions	**Recovery of failed train**	***Remaining* Mitigation Capability Rating for each affected sequence**	**Sequence Color**
1 TRANS - AFW - PCS - FB			
2 TRANS - AFW - PCS -EIHP	**0**	**(AFW = 3) + (TDAFW = 1) + (PCS = 2) + (CHG = 3) Total = 9**	**GREEN RESULT**
2 TRANS - AFW - PCS - LPR			
3 TRANS - AfW - PCS - HPR	**0**	**(AFW = 3) + (TDAFW = 1) + (PCS = 2) + (HPR = 2) Total = 8**	**GREEN RESULT**

Identify any operator recovery actions[1] that are credited to directly restore the degraded equipment or initiating event:

Note 1: If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time i available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to th scenario assumed, and 5) any equipment needed to complete these actions is available and

PHASE 2 RISK ESTIMATION WORKSHEET — Small LOCA

Estimated Frequency (Table 1 Row) III **Exposure time** 7 days **Table 1 result (circle):** A B C (D) E F G H

Safety Functions Needed:	*Full* Creditable Mitigation Capability for each Safety Function:
Early Inventory, HP Injection (EIHP)	1 / 2 Charging or 1 / 2 SI trains (2 multi-train systems)
Power Conversion System (PCS)	1/3 condensate pump (1 multi-train system requires operator action)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 diverse train)
Primary Heat Removal, Feed/Bleed (FB)	1 / 2 PORVs open for Feed/Bleed (operator action under high stress)
High Pressure Recirc (HPR)	1 / 2 Charging trains or 1 / 2 SI trains taking suction from 1 / 2 LPSI trains (limited by LPSI= 1 multi-train system but also requires human action for switching the suction to sump))
Low Pressure Recirc (LPR)	1 / 2 LPSI trains (1 multi-train system but also requires manual switch over action)
Contmt Press/Temp Control (CNT)	1 / 2 CS trains in recirculation mode (1 multi-train system) or 3 / 5 CFCU trains (1 multi-train systems)

Circle affected functions	Recovery of failed train	*Remaining* Mitigation Capability Rating for each affected sequence	Sequence Color
1 SLOCA - EIHP	0	(Charging = 3) Total =3	D3 GREEN
2 SLOCA - AFW - PCS - FB			
3 SLOCA - AFW - PCS - CNT			
4 SLOCA - LPR			
5 SLOCA - HPR	0	(HPR =2 human action for switchover to sump) Total = 2	D2 WHITE RESULT

Identify any operator recovery actions[1] that are credited to directly restore the degraded equipment or initiating event:

Note 1: If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and

PHASE 2 RISK ESTIMATION WORKSHEET LOOP

Estimated Frequency (Table 1 Row) II **Exposure time** 7 days **Table 1 result (circle):** A B (C) D E F G H

Safety Functions Needed:	*Full* Creditable Mitigation Capability for each Safety Function:
Emergency AC Power (EAC)	2 / 3 Emergency Diesel Generators (3 EDGs= 1 multi-train system, 2EDG=1 diverse train) or 1 Gas Turbine Generator (1 diverse train)
Recovery of AC power in < 6 hrs (REC6)	Recover a source of AC to allow primary injection (Operator action under high stress)
Recovery of AC Power in < 2 hrs (REC2)	1 TDAFW train and SBO procedures, other than GTG, implemented (operator action under high stress)
Early Inventory, HP Injection (EIHP)	1 / 2 Charging trains (1 multi-train system) or 1 / 2 SI trains (1 multi-train system)
Secondary Heat Removal (AFW)	1 TDAFW train (1 train) or 1 / 2 MDAFW trains (1 multi-train system)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs open for Feed/Bleed (operator action under high stress)
Low Pressure Recirc (LPR)	1 / 2 LPSI trains (1 multi-train system but also requires manual switch over action)
High Pressure Recirc (HPR)	1 / 2 Charging trains or 1 / 2 SI trains taking suction from 1 / 2 LPSI trains (1 multi-train system but also requires human action for switching the suction to sump)
Contmt Press/Temp Control (CNT)	1 / 2 CS trains in Recirc. Mode (1 multi-train system) or 3 / 5 CFCU trains (1 multi-train systems)

Circle affected functions	Recovery of failed train	*Remaining* Mitigation Capability Rating for each affected sequence	Sequence Color
1 LOOP - EAC - REC6			
2 LOOP - EAC - REC2 - TDAFW			
3 LOOP - EAC - EIHP (RCP seal LOCA)	0	(EAC=3)+(GTG=2)+(EIHP=3) Total=8	GREEN
4 LOOP - EAC - REC2 - FB (RCP seal LOCA)			
5 LOOP - EAC - REC2 - LPR (RCP seal LOCA)			
6 LOOP - EAC - REC2 - HPR (RCP seal LOCA)	0	(EAC = 3) + (GTG = 2) + (REC2 = 1) + (HPR = 2) Total = 8	GREEN
7 LOOP - AFW - FB			
8 LOOP - AFW - LPR			
9 LOOP - AFW - HPR	0	(AFW = 3) + (TDAFW = 1) + (HPR =2) Total = 6	GREEN
10 LOOP - AFW - CNT			

Identify any operator recovery actions[1] that are credited to directly restore the degraded equipment or initiating event:

Note 1: If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and

PHASE 2 RISK ESTIMATION WORKSHEET SGTR

Estimated Frequency (Table 1 Row) III **Exposure time** 7 days **Table 1 result (circle):** A B C (D) E F G H

Safety Functions Needed:	***Full* Creditable Mitigation Capability for each Safety Function:**
Early Inventory, HP Injection (EIHP)	**1 / 2 Charging or 1 / 2 SI trains (2 multi-train systems)**
Secondary Heat Removal (AFW)	**1/2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 diverse train-assuming ruptured SG isolated)**
Primary Heat Removal, Feed/Bleed (FB)	**2 / 2 PORVs open for Feed/Bleed (operator action under high stress)**
Primary/Secondary pressure Equalization (EQ)	**Pressure equalization below SG safety setpoints (operator action under high stress) - Note: Failure to equalize is assumed to result in failure to isolate the SG (loss of SG inventory to atmosphere)**
Makeup CST (MKCST)	**Operator alignment of fire main system, demineralized water, service water to CST makeup (operator action)**
Makeup RWST (MKRWST)	**Operator alignment of borated water sources to RWST (operator action)**

Circle affected functions	**Recovery of failed train**	***Remaining* Mitigation Capability Rating for each affected sequence**	**Sequence Color**
1 SGTR - AFW - FB			
2 SGTR - EQ - EIHP	**0**	**(EQ = 1) + (Chg = 3) Total = 4**	**D4 GREEN**
3 SGTR - EQ - MKCST - FB			
4 SGTR - EQ - AFW - MKRWST			
5 SGTR - EQ - MKCST - MKRWST			
6 SGTR - AFW - EIHP	**0**	**(AFW = 3) + (TDAFW = 1) + (Chg = 3) Total = 7**	**GREEN**

Identify any operator recovery actions[1] that are credited to directly restore the degraded equipment or initiating event:

Note 1: If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and

Initiating Event Likelihood	Remaining Mitigation Capability Rating (with Examples)						
	6	5	4	3	2	1	0
	3 diverse trains OR 2 multi-train systems OR 1 train + 1 multi-train system + recovery of failed train	1 train + 1 multi-train system OR 2 diverse trains + recovery of failed train	2 diverse trains OR 1 multi-train system + recovery of failed train	1 train + recovery of failed train OR 1 multi-train system OR Operator action + recovery of failed train	1 train OR Operator action OR Operator action under high stress + recovery of failed train	Recovery of failed train OR Operator action under high stress	none
A	Green	White	Yellow	Red	Red	Red	Red
B	Green	Green	White	Yellow	Red	Red	Red
C	Green	Green	Green	White	Yellow	Red	Red
D	Green	Green	Green	Green	White	Yellow	Red
E	Green	Green	Green	Green	Green	White	Yellow
F	Green	Green	Green	Green	Green	Green	White
G	Green	Green	Green	Green	Green	Green	Green
H	Green	Green	Green	Green	Green	Green	Green

Table 2 - Risk Significance Estimation Matrix (rev 6/10/99)